STS 134, 135 & 26S Return Samples: Air Quality aboard Shuttle (STS-134) and International Space Station

Space Shuttle: The toxicological assessments of 2 canisters (mini-GSC or GSC) from the STS-134 Shuttle are reported in Table 1. Analytical methods have not changed from earlier reports. The percent recoveries of the 3 surrogates (^{13}C-acetone, fluorobenzene, and chlorobenzene) from the 2 Shuttle samples averaged 109, 101, and 88%, respectively. Based on the end-of-mission sample, the Shuttle atmosphere was acceptable for human respiration. Although samplers were available, no preflight or in-flight samples were obtained in association with STS-135.

Table 1. Analytical Summary of STS-134 Shuttle Samples (GSC in black and mini-GSC in blue)

Sample Location	Date of Sample	NMVOCs [a] (mg/m^3)	Freon 218 (mg/m^3)	T Value[b] (units)	Alcohols (mg/m^3)	Formaldehyde (µg/m^3)
Preflight	5/16/11	0.2	0	0.02	0.12	---
Flight-deck (end of mission)	6/01/11	2.4	17[c]	0.13	0.73	---

[a] Non-methane volatile organic hydrocarbons, excluding Freon 218
[b] Based on 7-day SMACs and calculated excluding CO_2, formaldehyde, and siloxanes
[c] Freon 218 is residual from the ISS during docked phase.

International Space Station: The toxicological assessment of 13 mini-GSCs from the ISS is shown in Table 2, along with formaldehyde data from two kit returns. The recoveries of the 3 standards (as listed above) from the mini-GSCs averaged 106, 108 and 85%, respectively. Although recoveries were widely dispersed, the average recovery of formaldehyde from 6 controls was 94%.

Table 2. Analytical Summary of ISS Results (mini-GSC in blue)

Module/Sample	Date of Sample	NMVOCs[a] (mg/m^3)	Freon 218 (mg/m^3)	T Value[b] (units)	Alcohols (mg/m^3)	Formaldehyde[c] (µg/m^3)		
						Approx.Date	Lab	SM
Lab	6/21/11	7.6	40	0.36	5.5	9/18/10	29	21
SM	6/21/11	8.6	25	0.40	6.0	10/15/10	25	20
JPM	6/21/11	8.9	18	0.40	6.3	11/24/10[c]	--	--
SM	7/05/11	7.9	29	0.37	5.5	12/22/10	42	22
Lab	7/05/11	6.1	56	0.31	4.4	1/15/11	40	27
Columbus	7/05/11	8.0	36	0.39	5.6	2/15/11	33	23
MPLM (first entry)	7/11/11	12	1	0.89	4.4	3/16/11	31	31
SM	8/1/11	7.8	20	0.33	6.3	4/14/11	27	27
Lab	8/1/11	6.1	21	0.33	4.8	5/5/11	34	24
JPM	8/1/11	5.7	17	0.33	4.4	6/2/11	29	27
SM	8/24/11	5.0	27	0.34	3.3	7/6/11	32	27
Columbus	8/24/11	5.2	26	0.35	3.6	8/2/11	26	26
Lab	8/24/11	5.4	15	0.35	3.7			
Guideline		*<25*	*none*	*<1.0*	*<5*	*<120*		

[a] Non-methane volatile organic hydrocarbons, excluding Freon 218
[b] Based on 180-d SMACs and calculated excluding CO_2 and formaldehyde. Siloxanes are now quantified in ISS samples.
[c] Formaldehyde badges returned on STS-134 and 26S. November 2010 results not reported due to uncertain time of badge exposure.

General Observations about ISS Air Quality:
This is a very limited set of samples on which to perform an air quality assessment. However, based on these samples, we have no reason to believe that nominal ISS air is unsafe to breathe. We must continue to be vigilant when dealing with nominal atmospheres in ISS. New, unmanned modules require special attention when the crew first enters.

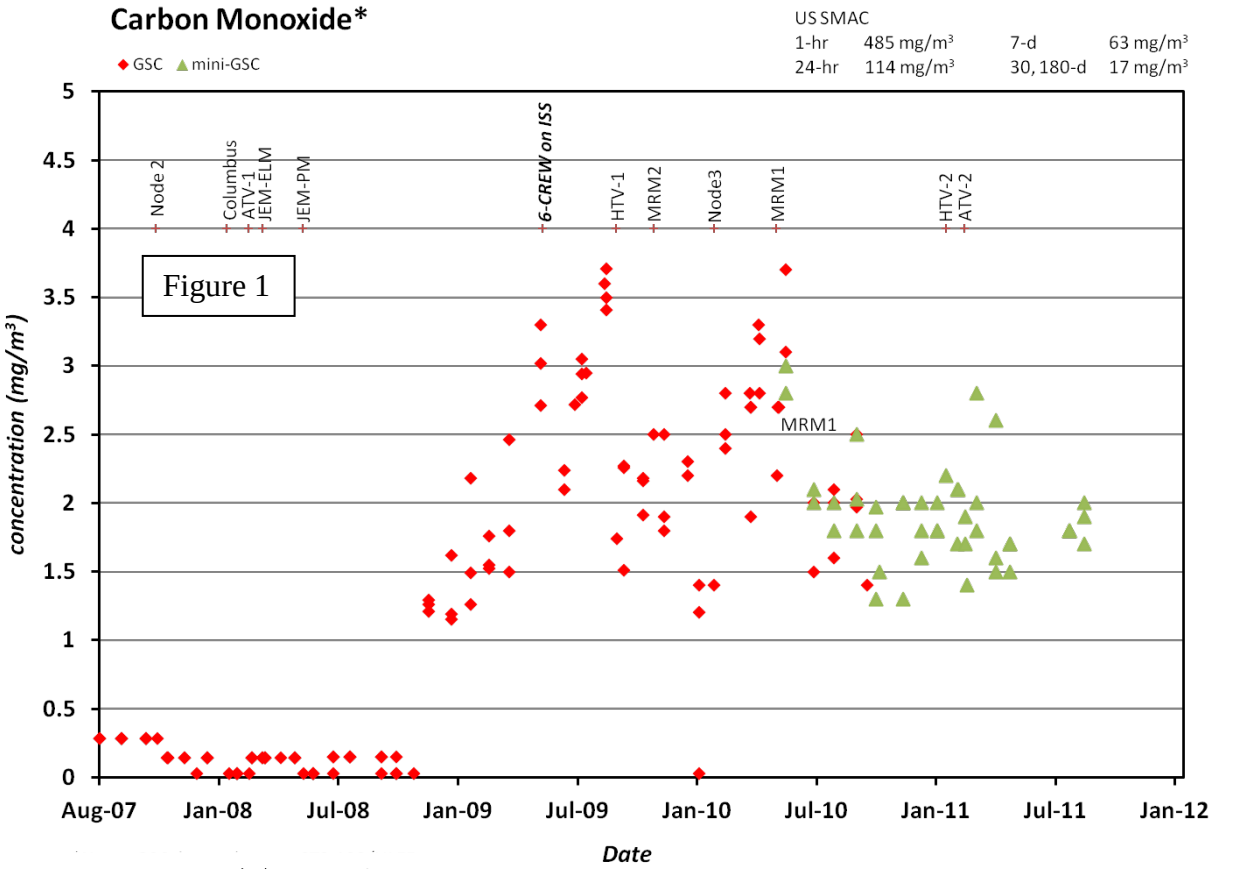
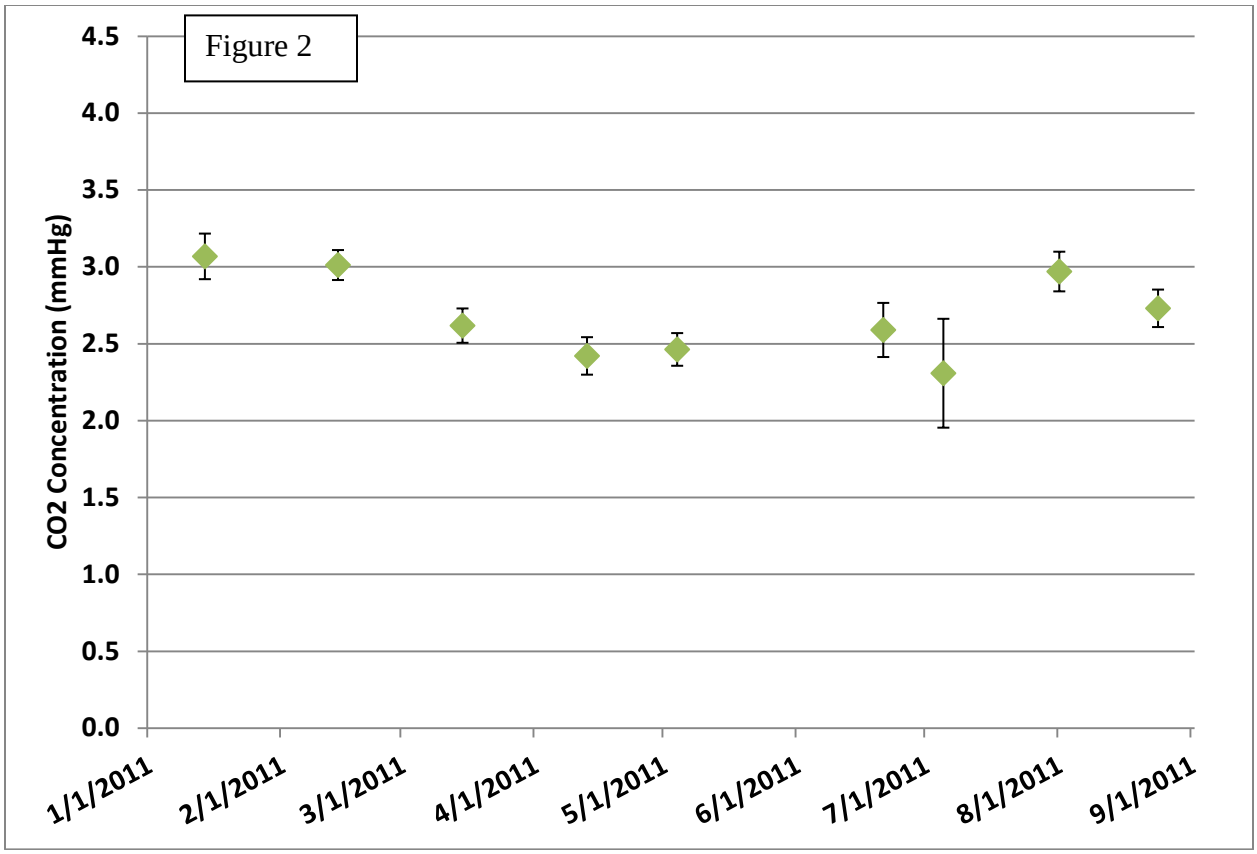


Figure 1

Carbon Monoxide Accumulation aboard ISS: Beginning in late 2008 the nominal concentrations of CO began increasing gradually (Figure 1). The results from samples returned on this flight indicate that the CO concentrations, after dropping in late 2009, have cycled upward and then settled back to concentrations near 2 mg/m^3. In any case, these changes are well below the 180-day SMAC for CO, which is17 mg/m^3. There is no threat to crew health.

Carbon Dioxide: This anthropogenic compound has drawn much attention recently because of the possibility that it could contirbute to the effects of intracranial hypertension experienced because of spaceflight-induced fluid shifts. From now on we will maintain a plot (Figure 2) of carbon dioxide concentrations (±SD) by averaging the values found in the 3-5 mini-GSC samples taken each month in diverse locations of the ISS. This will enable us to estimate the average exposure of crewmembers to carbon dioxide during their stay aboard the ISS. In general, concentrations are being maintained below 3.5 mmHg.



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Enclosures

Table 1A: Analytical concentrations of compounds found in the STS-134 samples
Table 1B: Analytical concentrations of compounds found in ULF7 samples
Table 1C: Analytical concentrations of compounds found in 26S return samples
Table 2A: T-values of the compounds in table 1A
Table 2B: T-values of the compounds in table 1B
Table 2C: T-values of the compounds in table 1C